Soil & Rock Logging Classification Manual

(Field Guide)

State of California
Department of Transportation
Engineering Service Center

OFFICE OF
STRUCTURAL FOUNDATIONS

August 1996

Preface

Detailed descriptions and classifications of soil and rock are an essential part of the information developed to support design and construction. Since the information presented is often developed over a prolonged period of time by more than one person, and results are often interpreted by numerous others, it is imperative that everyone uses standardized terminology. In an attempt to facilitate this goal, the Office of Structural Foundations has developed this manual. The information presented is generally based on the Engineering Geology Field Manual published by the Bureau of Reclamation. Minor changes and / or additions were made to the consistency and relative density descriptors, as well as the organic material classification procedures. Furthermore, this document contains figures that present proper sample identification, minimum material requirements for various laboratory tests, and appropriate paperwork for requesting sample testing by the Translab Geotechnical Laboratory.

Soil and Rock Classification Manual

Table of Contents

1.0 Soil Classification Procedures

Soil classification procedures presented in this manual generally use Bureau of Reclamation Standards as modified from the Unified Soil Classification System. These standards are fairly consistent with ASTM Designation: D 2488. When using this manual to classify soil, the detail of description provided for a particular material should be dictated by the complexity and objectives of the project. However, since field work completed for one purpose is often later used for another, an attempt should always be made to describe the soil as completely as possible.

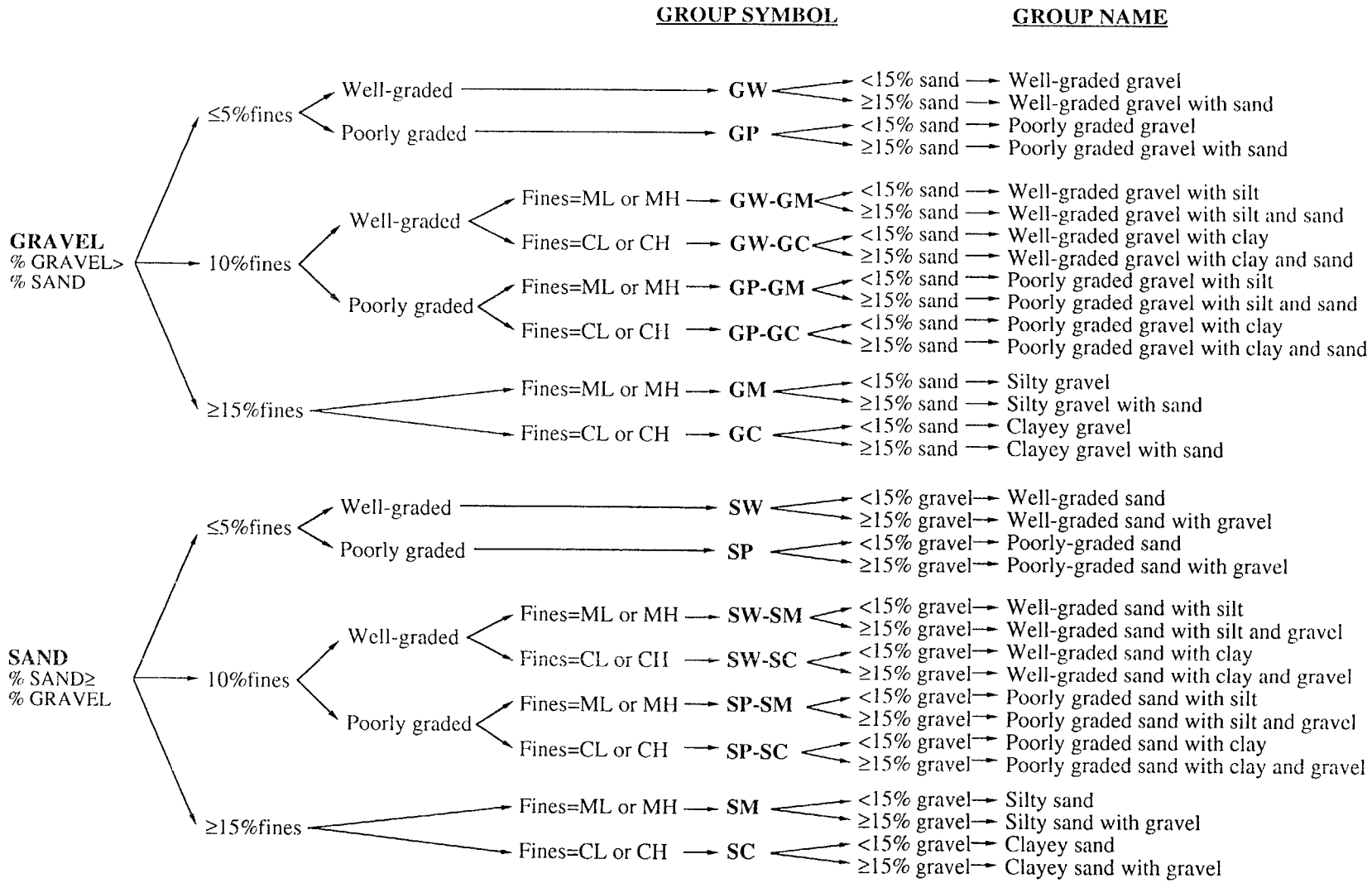
Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis.

1.1 Soil Classification Descriptive Sequence

Use the following descriptive sequence when classifying soils:

- Group Name
- Group Symbol
- Consistency/Relative Density
- Color
- Moisture
- Partical Size / Shape / Angularity
- Gradation
- Plasticity
- Structure
- Cementation
- Organics
- Fill Materials
- Other Constituents / Characteristics

C. Coarse Grained Soils (less than 50% fines)



Note: Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%. Fines are defined as material passing a No. 200 sieve.

1.3 Consistency Of Cohesive Soils

Cohesive soil consistency descriptors shall conform to terminology established herein. Note that the terms to be used have been modified from those contained in both Bureau of Reclamation and ASTM standards.

The preferential procedure for the determination of consistency and strength of cohesive soils is to obtain undisturbed samples and measure the undrained shear strengths by performing laboratory tests or approximate the shear strengths with a pocket penetrometer or Torvane. The following table does not imply a valid correlation between SPT data and undrained shear strength. When determining the consistency of a SPT sample of a cohesive soil, use the pocket penetrometer value rather than the blow count.

(After Ref. 4, 5, 6, 7)

Consistency	Approx. Undrained Shear Strength Su KN/m^2	(ksf)	SPT N-value blows /.3 m	Field Approximation
Very soft	≤ 12	(<1/4)	< 2	Squeezes between fingers when fist is closed; easily penetrated several inches by fist.
Soft	13 - 25	(1/4-1/2)	2 - 4	Easily molded by fingers; easily penetrated several inches by thumb.
Firm	26 - 50	(1/2- 1)	5 - 8	Molded by strong pressure of fingers; can be penetrated several inches by thumb with moderate effort.
Stiff	51 - 75	(1-1 1/2)	9 - 15	Dented by strong pressure of fingers; readily indented by thumb but can be penetrated only with great effort.
Very stiff	76 - 100	(1 1/2-2)	16 - 30	Readily indented by thumbnail.
Hard	> 100	(>2)	> 31	Indented with difficulty by thumbnail.

1.4 Relative Density for Cohesionless (Granular) Soils

Relative density descriptors for cohesionless soil shall be based on the following table:

(After Ref. 1, 4)

Relative Density	SPT N-value blows /.3 m	Field Approximation
Very loose	0 - 4	Easily penetrated 30 cm with 13 mm rebar pushed by hand.
Loose	5 - 10	Easily penetrated several cm with 13 mm rebar pushed by hand.
Medium dense	11 - 30	Easily to moderately penetrated with 13 mm rebar driven by 2.3 kg hammer.
Dense	31 - 50	Penetrated 0.3 m with difficulty using 13 mm rebar driven by 2.3 kg hammer.
Very dense	>50	Penetrated only a few cm with 13 mm rebar driven by 2.3 kg hammer.

1.5 Soil Colors

The Munsell Color System should be used to describe soil color.

1.6 Moisture Designations

Term	Field Identification
Dry	Absence of moisture. Dusty. Dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, usually soil is below water table.

1.7 Particle Size

Descriptive Term	Size	Familiar Examples
Boulder	>300 mm (> 12 in.)	Larger than a basketball
Cobble	300 mm to 75 mm (12 in. to 3 in.)	Grapefruit - Orange - Volleyball
Coarse Gravel	75 mm to 20 mm (3 in. to 3/4 in.)	Tennis ball - Grape
Fine Gravel	20 mm to 4.75 mm (3/4 in. to #4)	Pea
Coarse Sand	4.75 mm to 2.0 mm (#4 to #10)	Rock salt
Medium Sand	2.0 mm to 0.425 mm (#10 to #40)	Opening in window screen
Fine Sand	0.425 mm to 0.075 mm (#40 to #200)	Sugar - Table salt

1.8 Particle Shape

Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in the following table; otherwise, do not mention. Indicate the fraction of the particles that have the shape, such as: one-third of gravel particles are flat.

Criteria for Describing Particle Shape	
The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.	
Flat	Particles with $\frac{\text{width}}{\text{thickness}}$ >3
Elongated	Particles with $\frac{\text{length}}{\text{width}}$ >3
Flat and elongated	Particles meet criteria for both flat and elongated

1.9 Particle Angularity

Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded as indicated by the criteria in the following table.

A range of angularity may be stated, such as: subrounded to rounded.

Criteria for Describing Angularity of Coarse-grained Particles	
Angular	Particles have sharp edges and relatively planar sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly planar sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

1.10 Granular Gradation Terminology

(After Ref. 1, 3)

Gradation Term (USCS)	Description
Well-graded (GW, SW)	Full range and even distribution of grain sizes present.
Poorly-graded (GP, SP)	Narrow range of grain sizes present.
Uniformly-graded (GP, SP)	Consists predominantly of one grain size.
Gap-graded (GP, SP)	Within the range of grain sizes present, one or more sizes are missing.

1.11 Degree of Plasticity

Term	Field Test (approximation)
Nonplastic	A 3 mm thread cannot be rolled at any water content.
Low Plasticity	The thread can barely be rolled, and crumbles easily.
Medium Plasticity	The thread is easy to roll, and not much time is required to reach the plastic limit before crumbling.
High Plasticity	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times before crumbling.

1.12 Structure (Fabric)

Describe the structure of the soil being observed. The descriptors presented are for soils only; not synonymous with descriptors for rock.

Term	Structure Criteria
Varved	Alternating 1 mm - 12 mm layers of sand, silt, and clay.
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness.
Fissured	Contains shears or separations along planes of weakness.
Slickensided	Shear planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout.

1.13 Cementation of Coarse-Grained Soils

A sample containing less than 50 percent fines is identified as a coarse-grained soil.

Term	Cementation Criteria
Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

1.14 Organic Material

Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread of the toughness test will be spongy.

(Ref. 8)

Term	Organic Percent (by volume) of Total Sample	
PEAT	50 - 100	Primary Constituent
Organic (soil name)	15 - 50	Secondary Organic Constituent
(Soil name) with some organics	5 - 15	Additional Organic Constituents

1.15 Fill Materials

All soils should be examined to see if they contain materials indicative of man-made fills. Man-made fill items should be listed in each of the soil descriptions. Common fill indicators include glass, brick, dimensioned lumber, concrete, pavement sections, asphalt, metal, plastics, plaster, etc. Other items that could suggest fill include buried vegetation mats, tree limbs, stumps, etc. The soil description for a fill material should be followed by the term "(Fill)", i.e., for a sandy silt with some brick fragments the description would be "SANDY SILT (ML), with brick fragments (Fill)". The size and distribution of fill indicators should be noted. The limits (depth range) of fill material should be determined and identified at each exploration location.

1.16 Other Constituents / Characteristics

A. Additional constituents and / or pertinent soil characteristics not included in the previous categories should be described depending on the scope and objectives of the project. Observations that may be discussed include:

- Oxide staining
- Odor
- Origin
- Presence of root cast
- Presence of mica
- Presence of gypsum
- Presence of calcium carbonate
- Percent by volume of cobbles & boulders with size description and appropriate rock classification

B. Other pertinent information from the exploratory program should be recorded, if it would be useful from a biddability / constructability perspective. The conditions that should be listed include caving or sloughing, difficulty in drilling, and inflow of groundwater.

1.17 Inorganic Fine-Grained Soil Characteristics

A. Identification Procedures

Identification of Inorganic Fine-grained Soils From Manual Tests

Group Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

The properties of an elastic silt are similar to those for a lean clay. However, the silt will dry quickly on the hand, and when dry, it will have a smooth silky feel. Some soils which one would classify as MH according to the field classification criteria are difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing to ensure proper classification.

B. Dry Strength, Dilatancy, and Toughness Descriptive Terminology

The following tables define descriptive terminology associated with dry strength, dilatancy, and toughness. This information should be used as an aid when identifying inorganic fine-grained soils. The results of these field tests need not be included in the field log.

Criteria for Describing Dry Strength

None	The dry specimen crumbles with the slightest pressure of handling.
Low	The dry specimen crumbles with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. The specimen will break into pieces between the thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

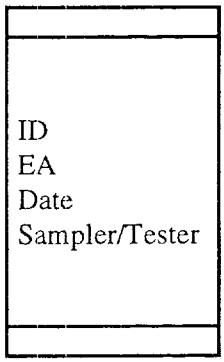
1.17 Inorganic Fine-Grained Soil Characteristics (continued)

Criteria for Describing Dilatancy	
None	No visible change in the specimen.
Slow	Water slowly appears on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water quickly appears on the surface of the specimen during shaking and disappears upon squeezing.

Criteria for Describing Toughness	
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and very soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump are soft.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump are firm.

1.18 Identification for Tubes, Jars, Plastic Bags / Baggies, and Reclosable Top Soil Containers

Tube/Liner/Shelby



Sample I.D.
(for Tubes)

B1 - 2 - III

- III — Tube No.
- 2 — Sample No.
- B1 — Boring No.

Seal partially filled tubes with wax plug.

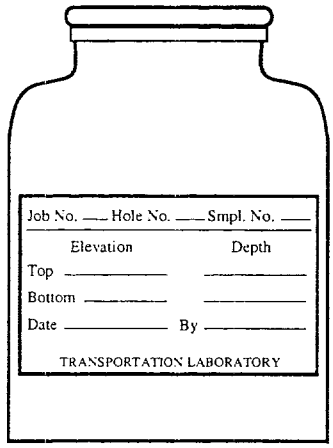
Stuff remainder of tube with newspaper, cloth rags, or sawdust.

Use black electrical tape to seal end caps on the tube.

Use black **permanent** marker, only.

For a sample comprised of multiple tubes, number the tubes sequentially starting at the tip of the sample.

Jar



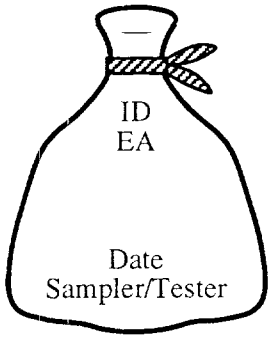
Labels are provided

Sample I.D.
(for Jars)

B1 - 2

- 2 — Sample No.
- B1 — Boring No.

Plastic Bag/Baggie

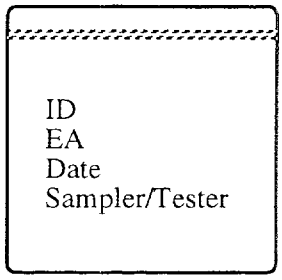


Sample I.D.
(for Bags)

B1 - 2

- 2 — Sample No.
- B1 — Boring No.

Reclosable Top Plastic Bag



Paper inserts shall be protected.

On the bag, use a black **permanent** marker, only.

Be advised that some plastic bags are made to "breath" air, which could affect the sample moisture content.

1.19 Identification for Canvas Bag Soil Containers

TL-101 (REV. 8-76)

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SAMPLE IDENTIFICATION CARD NO. C231933

☐ PRELIMINARY TESTS
☐ PROCESS TESTS
☐ ACCEPTANCE TESTS
INDEPENDENT ASSURANCE TESTS
☐ DIST. LAB
☐ TRANS. LAB
☐ SPECIAL TESTS

SAMPLE SENT TO
☐ HDQTRS. LAB
☐ BRANCH LAB
☐ DIST. LAB

FIELD NO.
DIST. LAB NO.
LOT NO.
SHIPMENT NO.
P. O. OR REQ. NO.
AUTHORIZATION NO.

SAMPLE OF
FOR USE IN
SAMPLE FROM
DEPTH
LOCATION OF SOURCE

THIS SAMPLE IS SHIPPED IN (NO. CONTAINERS) AND IS ONE OF A GROUP OF SAMPLES REPRESENTING (TONS, GALS., BBLS., STA., ETC.)

OWNER OR MANUFACTURER

TOTAL QUANTITY AVAILABLE
TEST RESULTS DESIRED
☐ NORMAL ☐ PRIORITY DATE NEEDED

REMARKS

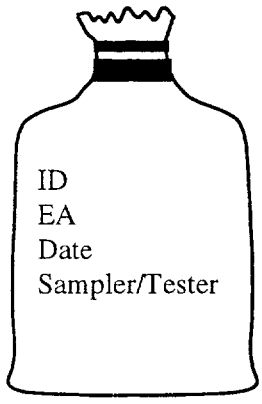
COVER ADDITIONAL INFORMATION WITH LETTER

DATE SAMPLED
BY TITLE

DIST., CO., RTE., P.M.
LIMITS
CONT. NO.
FED. NO.
RES. ENGR. OR SUPT.
ADDRESS
CONTRACTOR

MAIL TO SAME DESTINATION AS SAMPLE

Canvas Bag



If sample is wet, moist or damp, use a plastic bag as a liner for canvas bag. The TL-101 form **must** always be inside the canvas bag. Be sure to seal the TL-101 inside a baggie to help prevent moisture damage.

On the bag, use a black **permanent** marker only!

Sample I.D.
(for Canvas Bags)

B1 - 2

Sample No.
Boring No.

1.20 Material Requirements for Various Test Methods

California Test Method	Test Name		Min. Material Weight for Indicated Test	Typical Sample Size
202	Sieve Analysis		10 kg	1 Bag
203	Mechanical Analysis (Hydrometer)		0.4 kg	1 Tube
204	Atterberg Limits		0.4 kg	1 Tube
209	Specific Gravity		0.2 kg	1/2 Tube
216	Relative Compaction		35 kg	**2 Full** Bags
219	Consolidation			
	Undisturbed	51 mm (2")	-	1 Tube
		71 mm (2.8")	-	1 Tube
		102 mm (4")	-	1 Tube
		152 mm (6")		1 Tube
	Remolded	51 mm (2")	35 kg	**2 Full** Bags
		71 mm (2.8")	35 kg	**2 Full** Bags
		102 mm (4")	35 kg	**2 Full** Bags
		152 mm (6")	50 kg	**3 Full** Bags
220	Permeability			
	Undisturbed			
		Falling Head	-	1 Tube
	Remolded			
		Falling Head	35 kg	**2 Full** Bags
		Constant Head	35 kg	**2 Full** Bags
221	Unconfined Compression			
	Undisturbed		-	1 Tube
	Remolded		35 kg	**2 Full** Bags
222	Direct Shear			
	Undisturbed		-	1 Tube
	Remolded		35 kg	**2 Full** Bags
226	Moisture		0.2 kg	1/2 Tube
230	Triaxial (3 points)			
	Undisturbed	51 mm (2")	-	3 Tubes
		71 mm (2.8")	-	3 Tubes
		102 mm (4")	-	3 Tubes
		152 mm (6")	-	3 Tubes
	Remolded	51 mm (2")	35 kg	**2 Full** Bags
		71 mm (2.8")	35 kg	**2 Full** Bags
		102 mm (4")	50 kg	**3 Full** Bags
		152 mm (6")	100 kg	**6 Full** Bags

Notes:

1. **Always completely fill baggies and canvas bags!** Remember, it is easier for Laboratory Personnel to throw excess material away compared to the difficulty of obtaining additional material.
2. Minimum material weights shown for remolded samples include sufficient material for the development of a moisture density curve.
3. A 300 mm by 600 mm canvas bag completely filled contains approximately 17.5 kg of material.
4. A 50 mm by 100 mm long tube contains approximately 0.4 kg of material.
5. When calculating the number of triaxial samples that can be obtained from a Shelby Tube, use a minimum sample length equal to three times the sample diameter.

1.21 Geotechnical Laboratory Tracking Form

When samples are submitted to the Geotechnical Laboratory for testing, the person requesting laboratory services is required to complete a Geotechnical Laboratory Tracking Form. A reduced copy of this form is shown below. Full sized copies of this form may be obtained from Geotechnical Laboratory personnel.

OFFICE OF STRUCTURAL FOUNDATIONS
GEOTECHNICAL LABORATORY TRACKING FORM

GEOTECHNICAL LABORATORY JOB NUMBER: ☐*

Project Name	EA No. -	Remarks
	Act. Code	
	MSA Code	
Structure No.	Subjob	
Client	Special Designation:	Estimated Hours/Weeks Hrs Wks Actual Hours/Weeks Hrs Wks
Staff Staff Phone No	Dist Co Rte PM	T-101 No
Date Samples Taken in Field: Start End	Date Samples Received	Date Testing Program Rec'd From Client:
Date Testing Started	Date Samples to Grade Bench:	Date Samples from Grade Bench:
Date Testing Completed	Date Testing Due:	Client Due Date:

Clients: DC= District Construction; DM = District Maintenance; DME=Dist Mat. Engr; DPD = District Project Development; L = Legal; GS=Geotech Support; RG=RW Geotech;SF=Structure Foundations; OSC = Structure Construction; OSD = Structure Design; OSM = Structure Maintenance

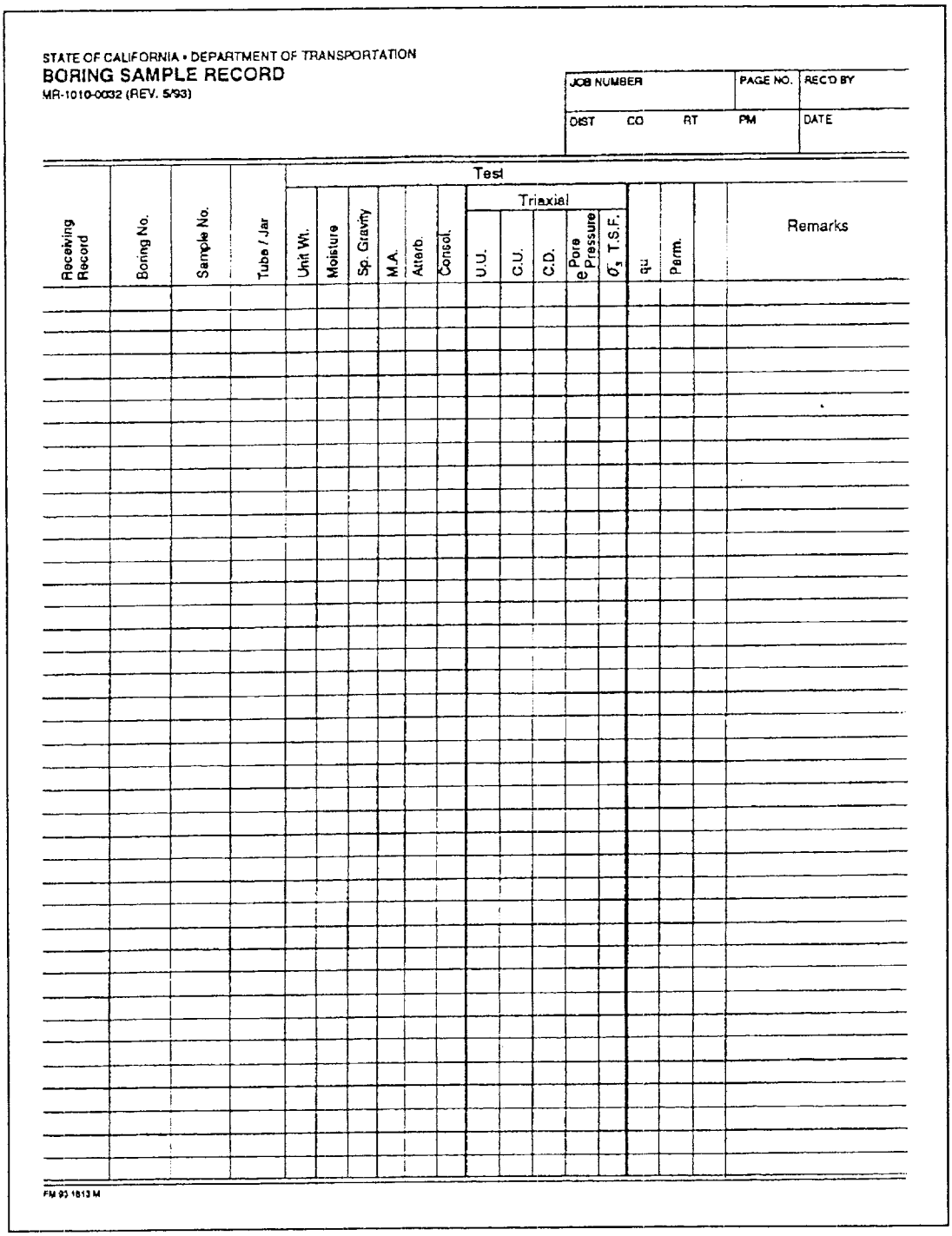
		Number Tests/Samples Requested	Number Tests/Samples Completed	Date Testing Started	Date Testing Completed
1.	Unit Weight				
2.	Moisture Content				
3.	Specific Gravity				
4.	Mechanical Analysis				
5.	Plasticity Index				
6.	Consolidation				
7.	Triaxial - UU				
8.	Triaxial - CUe				
9.	Triaxial - CD				
10.	Triaxial - Bump				
11.	Unconfined Compression - qu				
12.	Direct Shear				
13.	Permeability - Falling Head				
14.	Permeability - Constant Head				
15.	Compaction Curve				
16.	CA 216 Tube Calibration				
17.	Max-Min Density				
18.	Shrinkage Limit				
19.	Swell Pressure				
20.	Swell Volume				
21.	Pin Hole				
22.	Wick Drain				
23.					
24.					

* Check Box if There is a job add-on to this job.

Revised 7/17/96

1.22 Boring Sample Record

Geotechnical Laboratory Testing should be requested on a Boring Sample Record form. All the samples obtained in the field should be listed on this form. A reduced copy of this form is shown below. Full sized copies of this form may be obtained from Geotechnical Laboratory personnel.



STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
BORING SAMPLE RECORD
MR-1010-0032 (REV. 5/93)

JOB NUMBER		PAGE NO.	RECD BY
DIST CO RT		PM	DATE

Receiving Record	Boring No.	Sample No.	Tube / Jar	Test: Unit Wt.	Moisture	Sp. Gravity	M.A.	Atterb.	Consol.	Triaxial: U.U.	C.U.	C.D.	Pore Pressure	σ_3 T.S.F.	q_u	Perm.		Remarks

FM 93 1813 M

2.0 Rock Classification Procedures

Rock classification procedures presented in this manual generally use Bureau of Reclamation Standards. The detail of description provided for a particular material should be dictated by the complexity and objectives of the project. However, since field work completed for one purpose is often later used for another, an attempt should always be made to describe rock as completely as possible.

Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis.

2.1 Rock Classification Descriptive Sequence

Use the following descriptive sequence when classifying rocks:

- **Rock Name**
- **Color**
- **Degree of Weathering**
- **Relative Hardness**
- **Bedding**
    - Spacing
    - Attitude
- **Discontinuity Characteristics**
    - Type (list diagnostic feature such as striations, slickensides, etc.)
    - Attitude
    - Density / Spacing*
    - Openness / Filling
    - Roughness
    - Continuity* / Ends*
    - Moisture*
    - Healing
    - Shear / Fault
- **Core Recovery (show recovered length / core run length)**
- **RQD**
- **Voids**
- **Slaking**
- **Odor**
- **Other Rock Characteristics**

* For Field Mapping only

[9] Modified after R.B. Travis (1955)

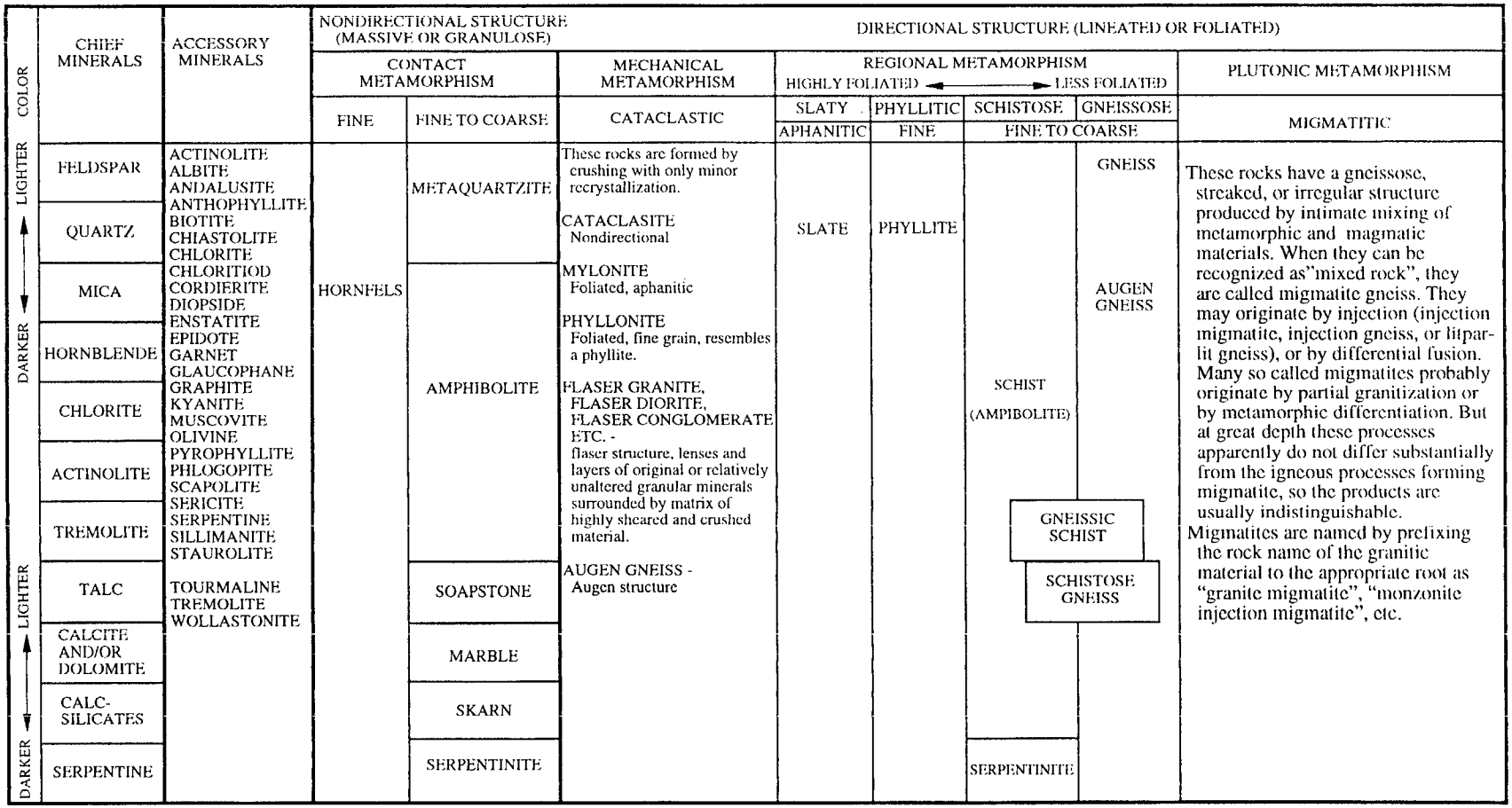
Color		Light → Dark									Special Types
Quartz		>10%	<10%	>10%	<10%	>10%		<10%		Chiefly Pyroxene and/or Olivine	
Feldspar		Potassium Feldspar >2/3 Total Feldspar		Potassium Feldspar 1/3-2/3 Total Feldspar		Plagioclase >2/3 Total Feldspar					
						K-Spar >10% Total	Sodic Plagioclase		Calcic Plagioclase		
Chief Accessory Minerals		Hornblende Biotite Muscovite		Hornblende Biotite Pyroxene		Hornblende Biotite Pyroxene			Pyroxene Olivine	Serpentine Iron Ore	**PEGMATITE** - Very coarse grained, normally silicic, rock (or small irregular mass).
Fine to coarse 0.1 to 10 mm	**Equigranular** Batholiths, lopoliths, stocks, large laccoliths, thick dikes & sills.	GRANITE	SYENITE	QUARTZ MONZONITE	MONZONITE	GRANO-DIORITE	QUARTZ DIORITE	DIORITE	GABBRO	PERIDOTITE	**APLITE** - Fine-grained rock having sugary texture.
Porphyritic*	**Fine to coarse grain ground mass** Laccoliths, dikes, sills, plugs, small stocks, margins of larger masses	GRANITE PORPHYRY	SYENITE PORPHYRY	QUARTZ MONZONITE PORPHYRY	MONZONITE PORPHYRY	GRANO-DIORITE PORPHYRY	QUARTZ DIORITE PORPHYRY	DIORITE PORPHYRY	GABBRO PORPHYRY	PERIDOTITE PORPHYRY	**LAMPROPHYRE**- Dark rock with high percentage FeMg materials as phenocrysts and in ground mass.
Porphyritic*	**Aphanitic ground mass** Dikes, sills, laccoliths, surface flows, margins of larger masses, welded tuffs.	RHYOLITE PORPHYRY	TRACHYTE PORPHYRY	QUARTZ LATITE PORPHYRY	LATITE PORPHYRY	DACITE PORPHYRY		ANDESITE PORPHYRY	BASALT PORPHYRY	RARE	* **TRAP**- Dark-colored aphanitic rock.
Aphanitic >0.1 mm	**Micro-crystalline** Dikes, sills, surface flows, margins of larger masses, welded tuffs.	RHYOLITE	TRACHYTE	QUARTZ LATITE	LATITE	DACITE		ANDESITE	BASALT		* **FELSITE**- Light-colored aphanitic rock.
Aphanitic >0.1 mm	**Glassy** Surface flows, margins of dikes and sills, welded tuffs.	**OBSIDIAN** - dark colored **PITCHSTONE** - resinous **VITROPHYRE** - porphyritic **PERLITE** - concentric fractures **PUMICE** - light colored, finely vesicular **SCORIA** - dark colored, coarsely vesicular		Normally it is not possible to determine the composition of these rocks. They are customarily designated by the names at the left. Basic glass is rare so rocks named, except scoria, will normally be silicic. If the approximate composition (by close association) can be determined, the name may be prefixed by the name of the appropriate aphanitic rock, for example, "trachyte obsidian" or "latite vitrophyre." In general, scoria is basic; basic obsidian is called "tachylite;" and spherulite tachylite is "variolite."							* These are somewhat vague terms and generally should not be used

* The names in these rows should be used if there are >50% phenocrysts. If there are <50% phenocrysts, the adjective "porphyritic" should be used, for example, "porphyritic granite."

TEXTURE →	GRAIN SIZE < 0.0625 mm			GRAIN SIZE 0.0625 - 2 mm						GRAIN SIZE > 2 mm	
	CRYSTALLINE, CLASTIC AMORPHOUS, BIOCLASTIC, ETC.			CLASTIC						CLASTIC	
COMPOSITION OF MAJOR FRACTION	CLAY MINERALS or Clay-size Material	Composition as indicated in left column	CHIEFLY CALCITE or DOLOMITE	CHIEFLY QUARTZ	QUARTZ with 10-25 % FELDSPAR	QUARTZ with >10 % ROCK FRAGMENTS	QUARTZ with > 25 % FELDSPAR	QUARTZ FELDSPAR ROCK FRAGMENTS	PYROCLASTICS	CHIEFLY ONE CONSTITUENT Homogeneous breccias and conglomerates	SEVERAL CONSTITUENTS Mixed breccias and conglomerates
COMPOSITION OF MINOR FRACTION: < 10 % MINOR FRACTION			LIMESTONE DOLOMITE ETC.	QUARTZOSE SANDSTONE	FELDSPATHIC SANDSTONE	LITHIC SANDSTONE	ARKOSE	GRAYWACKE	Refer to Section 2.5 for classification of Pyroclastics	Name consists of chief constituent and size, as QUARTZ. COBBLE CONGLOMERATE, LIMESTONE PEBBLE BRECCIA, ETC.	Name consists of "mixed" and size, as MIXED BOULDER BRECCIA. Name may include composition as ANDESITE-CHERT-ARKOSE CONGLOMERATE
COMPOSITION OF MINOR FRACTION: CLAY MINERALS or Clay-size Material	CLAYSTONE, SILTSTONE - nonfissile SHALE - fissile ARGILLITE - highly indurated BENTONITE - sodium montmoril - linite		ARGILLACEOUS LIMESTONE, MARL, ETC.	ARGILLACEOUS QUARTZOSE SANDSTONE	ARGILLACEOUS FELDSPATHIC SANDSTONE	ARGILLACEOUS LITHIC SANDSTONE	ARGILLACEOUS ARKOSE	ARGILLACEOUS GRAYWACKE		ARGILLACEOUS (SIZE) CONGLOMERATE	ARGILLACEOUS MIXED CONGLOMERATE, GLACIAL TILL FANGLOMERATE
COMPOSITION OF MINOR FRACTION: SILICA OPAL CHALCEDONY QUARTZ CHERT	SILICEOUS SHALE, SILICEOUS CLAYSTONE, ETC.	DIATOMITE, RADIOLARITE, SILICEOUS OOLITE, OOLITE CHERT	SILICEOUS LIMESTONE, CHERTY LIMESTONE, ETC.	SILICEOUS QUARTZOSE SANDSTONE	SILICEOUS FELDSPATHIC SANDSTONE	SILICEOUS LITHIC SANDSTONE	SILICEOUS ARKOSE	SILICEOUS GRAYWACKE		SILICEOUS (SIZE) CONGLOMERATE	SILICEOUS MIXED (SIZE) CONGLOMERATE
COMPOSITION OF MINOR FRACTION: CALCITE or DOLOMITE	CALCAREOUS SHALE, ETC.	LIMESTONE DOLOMITE, CLASTIC LIMESTONE CALICHE - lime-rich deposit form near surface OOLITE LIMESTONE FOSSILIFEROUS LIMESTONE CHALK		CALCAREOUS QUARTZOSE SANDSTONE	CALCAREOUS FELDSPATHIC SANDSTONE	CALCAREOUS LITHIC SANDSTONE	CALCAREOUS ARKOSE	CALCAREOUS GRAYWACKE		CALCAREOUS (SIZE) CONGLOMERATE	CALCAREOUS MIXED (SIZE) CONGLOMERATE

Rocks including significant quantities of iron, carbon, or miscellaneous salts follow the above format.
for example: ferruginous quartzose sandstone, coal, carbonaceous shale, gypsum, phosphatic limestone.

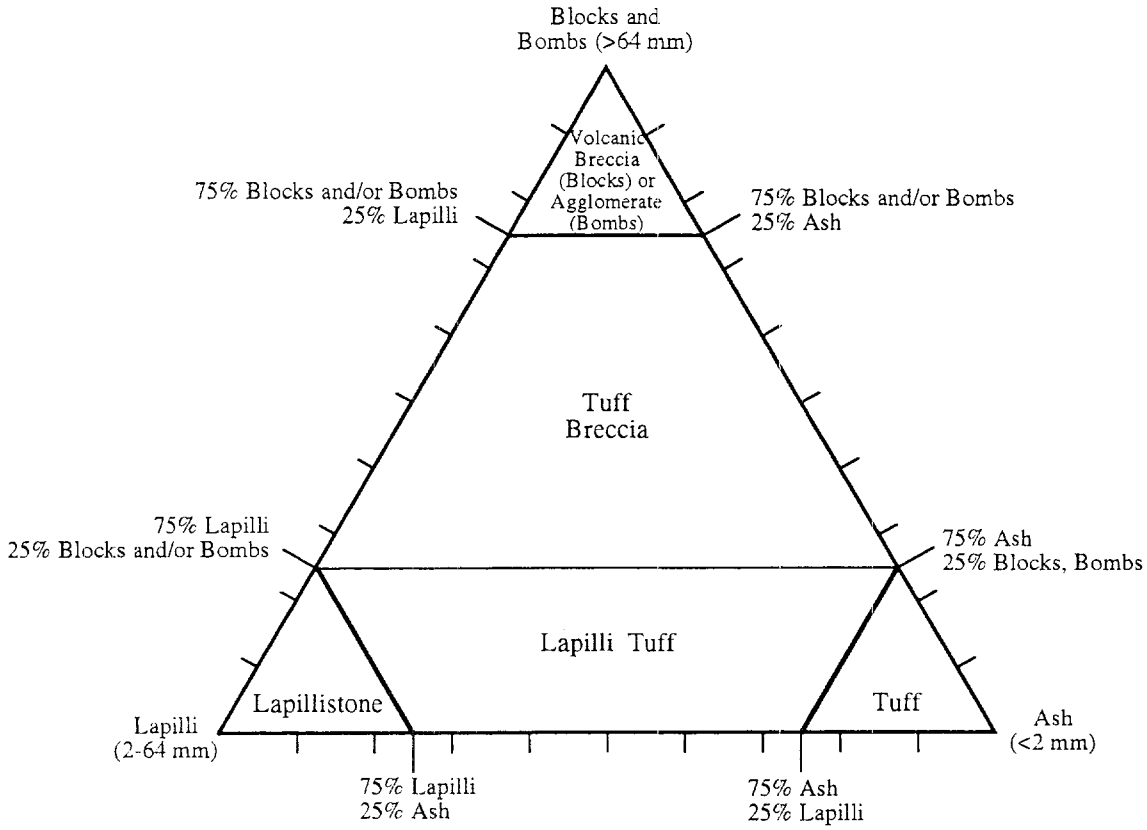
[9] (Modified after R.B. Travis [1955])



Naming a metamorphic rock consists chiefly of prefixing the structural term with mineral names or an appropriate rock name. The rock name indicates either the original rock, if recognizable, or the new mineral composition. The prefix "meta", as "Metagabbro "metasandstone", "metatuff", etc., is applied to rocks that have undergone considerable recrystallization but have largely retained their original fabric. Most of the minerals listed as accessories are genetically important and if present should be included in the rock name regardless of their quantity.

(Modified after R.B. Travis [1955])

2.5 Field Classification of Pyroclastic Rocks



Blocks are angular to subangular clasts >64 mm; bombs are rounded to subrounded clasts >64 mm. Determine the percent of each size present (ash, lapilli, blocks, and bombs) and list in decreasing order after the rock name. Precede the rock name with the term "welded" for pyroclastic rocks which have retained enough heat to fuse after deposition. Rock names for such deposits will usually be selected from the lower right portion of the classification diagram above. (Modified from Fisher, 1966 [11] and Williams and McBirney, 1979 [12]).

2.6 Rock Colors

Rock colors should be established using a Munsell Rock Color Chart based on standards from the Inter Society Color Council - National Bureau of Standards.

Descriptors	Diagnostic features					General characteristics (strength, excavation, etc.) §
	Chemical weathering-Discoloration and/or oxidation		Mechanical weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and solutioning		
	Body of rock	Fracture surfaces †		Texture	Solutioning	
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No solutioning	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
Slightly weathered to fresh°						
Slightly weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals may be noted	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
Moderately to slightly weathered°						
Moderately weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty", feldspar crystals are "cloudy".	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
Intensely to moderately weathered°						
Intensely weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, see grain boundary conditions	All fracture surfaces are discolored or oxidized, surfaces friable	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
Very intensely weathered						
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Note: This chart and its horizontal categories are more readily applied to rocks with feldspars and mafic minerals. Weathering in various sedimentary rocks, particularly limestones and poorly indurated sediments, will not always fit the categories established. This chart and weathering categories may have to be modified for particular site conditions or alteration such as hydrothermal effects; however, the basic framework and similar descriptors are to be used.

° Combination descriptors are permissible where equal distribution of both weathering characteristics are present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, dual descriptors should not be used where significant, identifiable zones can be delineated. When given as a range, only two adjacent terms may be combined (i.e., decomposed to lightly weathered or moderately weathered to fresh) are not acceptable.

† Does not include directional weathering along shears or faults and their associated features. For example, a shear zone that carried weathering to great depths into a fresh rock mass would not require the rock mass to be classified as weathered.

§ These are generalizations and should not be used as diagnostic features for weathering or excavation classification. These characteristics vary to a large extent based on naturally weak materials or cementation and type of excavation.

2.8 Rock Hardness / Strength Descriptors

Descriptor	Criteria
Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
Moderately hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
Moderately soft	Can be grooved 2 mm (1/16 inch) deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Any bedrock unit softer than very soft, is to be described using soil consistency descriptors.

Note: Although "sharp pick" is included in these definitions, descriptions of ability to be scratched, grooved or gouged by a knife is the preferred criteria.

2.9 Bedding, Foliation, or Flow Texture Descriptors

Descriptor	Thickness / Spacing
Massive	Greater than 3 m (10 ft)
Very thickly, (bedded, foliated, or banded)	1 to 3 m (3 to 10 ft)
Thickly	300 mm to 1 m (1 to 3 ft)
Moderately	100 to 300 mm (0.3 to 1 ft)
Thinly	30 to 100 mm (0.1 to 0.3 ft)
Very thinly	10 to 30 mm (0.03 [3/8 in] to 0.1 ft)
Laminated (intensely foliated or banded	Less than 10 mm (<0.03 ft [3/8in])

2.10 Standard Descriptors and Descriptive Criteria For Discontinuities

DISCONTINUITY TERMINOLOGY

DISCONTINUITY - A collective term used for all structural breaks in geologic materials which usually are unhealed and have zero or low tensile strength. Discontinuities also may be healed and exhibit high tensile strength. Discontinuities comprise fractures (including joints), planes of weakness, shears/faults, and shear/fault zones. Contacts between various units also may be considered discontinuities.

FRACTURE - A term used to describe any natural break in geologic material excluding shears and shear zones. Additional fracture terminology is provided below.

SHEAR - A structural break where differential movement has taken place along a surface or zone of failure by shear, characterized by striations, slickensides, gouge, breccia, mylonite, or any combination of these. Often direction, amount of displacement, and continuity may not be known because of limited exposures or observations.

FAULT - A shear with significant continuity which can be correlated between observations; occurs over a significant portion of a given site, foundation area, or region, or is a segment of a fault or fault zone defined in the literature. The designation of a shear as a fault or fault zone is a site-specific determination.

SHEAR/FAULT ZONE - A shear that is expressed in relative terms of width. The zone may consist of gouge, breccia, or many related faults or shears together with fractured and crushed rock between the shears or faults, or any combination of these. In the literature, many fault zones simply are referred to as faults.

SHEAR/FAULT DISTURBED ZONE - An associated zone of fractures and/or folds adjacent to shear or shear zone where the country rock has been subjected to only minor cataclastic action and may be mineralized. If adjacent to a fault or fault zone, the term is fault-disturbed zone. Occurrence, orientation, and area extent of these phenomena depend upon depth of burial (pressure and temperature) during shearing, brittleness of materials, and the stress envelope.

FRACTURE TERMINOLOGY

Examples shown for core, but applicable to any observation

JOINT (JT) - A relatively planar fracture along which there has been little or no shearing displacement.

FOLIATION JOINT (FJ) OR BEDDING JOINT (BJ) - A relatively planar fracture which is parallel to foliation or bedding along which there has been little or no shearing displacement.

BEDDING PLANE SEPARATION - A separation along bedding after extraction or exposure due to stress relief or slaking.

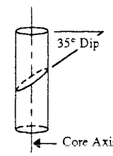
INCIPIENT JOINT (IJ) OR INCIPIENT FRACTURE (IF) - A joint or fracture which does not continue through the specimen or at least not seen with the naked eye. However when the specimen is wetted and then allowed to dry, the joint or fracture trace is evident. When core is broken, it breaks along an existing plane.

RANDOM FRACTURE (RF) - A natural break (fracture) with a generally rough, very irregular, nonplanar surface which does not belong to a joint set.

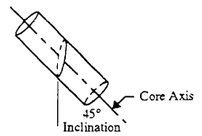
MECHANICAL BREAK (MB) - A break due to drilling, blasting, or handling. Mechanical breaks parallel to bedding or foliation are called Bedding Breaks (BB) or Foliation Breaks (FB), respectively. Recognizing mechanical breaks may be difficult. The absence of oxidation, staining, or mineral fillings, and often a hackly or irregular surface are clues for recognition.

FRACTURE ZONE (FZ) - Numerous, very closely intersecting fractures. Often fragmented core cannot be fitted together.

METHOD OF MEASURING DIP OF PLANAR DISCONTINUITIES, FOLIATION, AND BEDDING IN CORE



1. Vertical hole - true dip is measured and reported

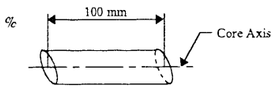


2. Angle hole - true dip usually not known, angle is measured from core axis and is called inclination

ROCK QUALITY DESIGNATION (RQD)

$$RQD = \frac{\text{Sum of length of solid core pieces} \geq 100 \text{ mm (0.33 ft [4 in]) long}}{\text{Length of the run in mm (ft)}} \times 100$$

Expressed as percent %



FRACTURE FREQUENCY

FRACTURE FREQUENCY - The number of natural fractures occurring within a base length or core run. The number of fractures is divided by the length and is reported as fractures per meter or fractures per foot. Expressed as 3/m or 6/ft.

FRACTURE DENSITY

FRACTURE DENSITY - Based on the spacing of all natural fractures in an exposure or core recovery lengths in boreholes; excludes mechanical breaks, shears, and shear zones; however, shear-disturbed zones (fractures outside the shear) are included. Descriptors for fracture density apply to all rock exposures such as tunnel walls, dozer trenches, outcrops, or foundation cut slopes and inverts, as well as boreholes. Descriptive criteria presented below are based on borehole cores where lengths are measured along the core axis, for other exposures the criteria is distance measured between fractures (size of blocks).

UNFRACTURED - No fractures.

VERY SLIGHTLY FRACTURED - Core recovered mostly in lengths greater than 1 m (3 feet).

SLIGHTLY TO VERY SLIGHTLY FRACTURED *

SLIGHTLY FRACTURED - Core recovered mostly in lengths from 300 to 1000 mm (1 to 3 feet) with few scattered lengths less than 300 mm (1 foot) or greater than 1000 mm (3 feet).

MODERATELY TO SLIGHTLY FRACTURED *

MODERATELY FRACTURED - Core recovered mostly in 100 to 300 mm (0.3 to 1.0 foot) lengths with most lengths about 200 mm (0.6 foot).

INTENSELY TO MODERATELY FRACTURED *

INTENSELY FRACTURED - Lengths average from 30 to 100 mm (0.1 to 0.3 foot) with scattered fragmented intervals. Core recovered mostly in lengths less than 100 mm (0.3 foot).

VERY INTENSELY TO INTENSELY FRACTURED *

VERY INTENSELY FRACTURED - Core recovered mostly as chips and fragments with a few scattered short core lengths.

* Combination of fracture densities (e.g. Very Intensely to Intensely Fractured, or Moderately to Slightly Fractured) are used where equal distribution of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

FRACTURE SPACING

JOINT SET, OR FRACTURE SPACING DESCRIPTOR	TRUE SPACING
EXTREMELY WIDELY SPACED	Greater than 3 m (>10 ft)
VERY WIDELY SPACED	1 to 3 m (3 to 10 ft)
WIDELY SPACED	300 mm to 1 m (1 to 3 ft)
MODERATELY SPACED	100 to 300 mm (0.3 to 1 ft)
CLOSELY SPACED	30 to 100 mm (0.1 to 0.3 ft)
VERY CLOSELY SPACED	Less than 30 mm (<0.1 ft)

FRACTURE CONTINUITY

CONTINUITY DESCRIPTOR	DISCONTINUITY LENGTH
DISCONTINUOUS	Less than 1 m (<3ft)
SLIGHTLY CONTINUOUS	1 to 3 m (3 to 10 ft)
MODERATELY CONTINUOUS	3 to 10 m (10 to 30 ft)
HIGHLY CONTINUOUS	10 to 30 m (30 to 100 ft)
VERY CONTINUOUS	Greater than 30 m (>100 ft)

FRACTURE ENDS (JOINT SURVEYS)

FRACTURE ENDS DESCRIPTOR	DESCRIPTIVE CRITERIA
EO	Zero ends leave the exposure (both ends can be seen).
E1	One end of the fracture terminates in the exposure (one end can be seen).
E2	Two fracture ends do not terminate in the exposure (both ends cannot be seen).

FRACTURE OPENNESS OR FILLING THICKNESS

FILLING THICKNESS DESCRIPTOR	THICKNESS/OPENNESS	OPENNESS DESCRIPTOR
CLEAN	No film or coating	
	No visible separator	TIGHT
VERY THIN	Less than 1 mm (<0.003 ft [1/32 in])	SLIGHTLY OPEN
MODERATELY THIN	1 to 3 mm (0.003 to 0.01 ft [1/32 to 1/8 in])	MODERATELY OPEN
THIN	3 to 10 mm (0.01 to 0.03 ft [1/8 to 3/8 in])	OPEN
MODERATELY THICK	10 to 30 mm (0.03 ft [3/8 in] to 0.1 ft)	MODERATELY WIDE
THICK	Greater than 30 mm (>0.1 ft) Actual thickness or openings recorded	WIDE

FRACTURE MOISTURE CONDITIONS

MOISTURE DESCRIPTOR	DESCRIPTIVE CRITERIA
M1	The fracture is dry. It is tight or filling (where present) is of sufficient density or composition to impede water flow. Waterflow along the fracture does not appear possible.
M2	The fracture is dry with no evidence of previous waterflow. Waterflow appears possible.
M3	The fracture is dry but shows evidence of waterflow such as staining, leaching, and/or vegetation.
M4	The fracture or filling (where present) is damp, but not free water present.
M5	The fracture shows seepage. It is wet with occasional drops of water.
M6	The fracture emits a continuous flow (estimate flow rate) under low pressure. Filling materials (where present) may show signs of leaching or piping.
M7	The fracture emits a continuous flow (estimate flow rate) under moderate to high pressure. Water is squirting and/or filling material (where present) may be substantially washed out.

FRACTURE ROUGHNESS

Refers to small scale asperities of surfaces, not large scale undulations or waviness.

STEPPED : Near-normal steps and ridges occur on the fracture surface.

ROUGH : Large, angular asperities can be seen.

MODERATELY ROUGH : Asperities are clearly visible and fracture surface feels abrasive.

SLIGHTLY ROUGH : Small asperities on the fracture surface are visible and can be felt.

SMOOTH : No asperities, smooth to the touch.

POLISHED : Extremely smooth and shiny.

FRACTURE SURFACE AND / OR FILLING ALTERATION AND HARDNESS

Descriptors for weathering or alteration of fracture surfaces and fracture fillings (excluding soil materials) are the same as those used for weathering and alteration of rock.

Descriptors for hardness/strength of fillings and/or fracture surfaces are the same as those presented for hardness of rock or consistency of soils.

DISCONTINUITY HEALING

TOTALLY HEALED - All fragments bonded, discontinuity is completely healed or recemented to a degree at least as hard as surrounding rock.

MODERATELY HEALED - Greater than 50 percent of fractured or sheared material, discontinuity surface or filling is healed or recemented; and/or strength of healing agent is less hard than surrounding rock.

PARTLY HEALED - Less than 50 percent of fractured or sheared material, discontinuity surface or filling is healed or recemented.

NOT HEALED - Discontinuity surface, fracture zone, sheared material, or filling is not healed or recemented. Rock fragments or filling (if present) held in place by their own angularity and/or cohesiveness.

SHEAR / FAULT DESCRIPTORS

SHEAR / FAULT GOUGE CONSISTENCY

Use descriptive criteria presented for consistency of Cohesive Soils as shown in Section 1.3.

SHEAR / FAULT GOUGE CONDITIONS

The apparent moisture content of gouge is described as WET (visible free water); MOIST (damp but no visible water); and DRY (absence of moisture, dusty, dry to the touch). Moisture descriptors M1 through M7 may be used to describe the shear or shear zone.

BRECCIA SHAPES

Angular .....

Subangular .....

Subrounded .....

Rounded .....

Platy .....

Lens-shaped .....

Wedge-shaped .....

Contorted .....

2.11 Igneous and Metamorphic Rock Grain Size Descriptors

Descriptor	Average crystal diameter
Very coarse-grained or pegmatic	>10 mm (> 3/8 in)
Coarse-grained	5-10 mm (3/16 - 3/8 in)
Medium-grained	1-5 mm (1/32 - 3/16 in)
Fine-grained	0.1 - 1 mm (0.04 - 1/32 in)
Aphanitic (cannot be seen with the unaided eye)	<0.1 mm (<0.04 in)

2.12 Sedimentary and Pyroclastic Rock Particle-size Descriptors

USCS (Soils only) Particle size	**Size in mm (inches)**	**Sedimentary (epiclastic)** Rounded, subrounded, subangular		**Volcanic** (pyroclastic)*	
		Particle or fragment	Lithified product	Fragment	Lithified product
Boulder	300 (12)	Boulder	Boulder conglomerate	Block	Volcanic breccia
Cobble	256 (10) 75(3)	Cobble	Cobble conglomerate	Bomb	Agglomerate
Coarse gravel	64 (2.5) 32 (1.3)	Pebble	Pebble conglomerate	Lapilli	Lapilli tuff
Fine gravel	20 (0.8) 4.75 (0.19)				
Coarse sand	4 (0.16) 2 (0.08)	Granule	Granule conglomerate		
Medium sand	1 (0.04) 0.5 (0.02)	Very coarse sand Coarse sand	Sandstone (Very coarse, coarse, medium, fine, or very fine)	Coarse ash	Coarse tuff
Fine sand	0.42 0.25 0.125	Medium sand Fine sand			
Fines Non-plastic Silt / Plastic Clay	0.074 0.0625 0.00391	Very fine sand Silt Clay	Siltstone, Shale Claystone, Shale	Fine ash	Fine tuff

* Refer to Section 2.5.

2.13 Textural Adjectives

- **Pit (pitted)**—1-10 mm (Pinhole to 0.03 ft [3/8 in]) openings.
- **Vug (vuggy)**—Small opening (usually lined with crystals) ranging in diameter from 10 to 100 mm (0.03 ft [3/8 in] to 0.33 ft [4 in]).
- **Cavity**—An opening larger than 100 mm (0.33 ft [4 in]), size descriptions are required, and adjectives such as small, or large, may be used, if defined.
- **Honeycombed**—If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
- **Vesicle (vesicular)**—Small openings in volcanic rocks of variable shape formed by entrapped gas bubbles during solidification.

2.14 Rate of Slaking

The following descriptors are used to identify the time to slake:

Slow slaking	——	Action continues for several hours.
Moderate slaking	——	Action completed within 1 hour.
Rapid slaking	——	Action completed within 2 minutes.
Sudden slaking	——	Complete reaction, action completed instantaneously.

(Slaking is generally used for shales; disaggregation is used mostly for soils.)

2.15 Odor

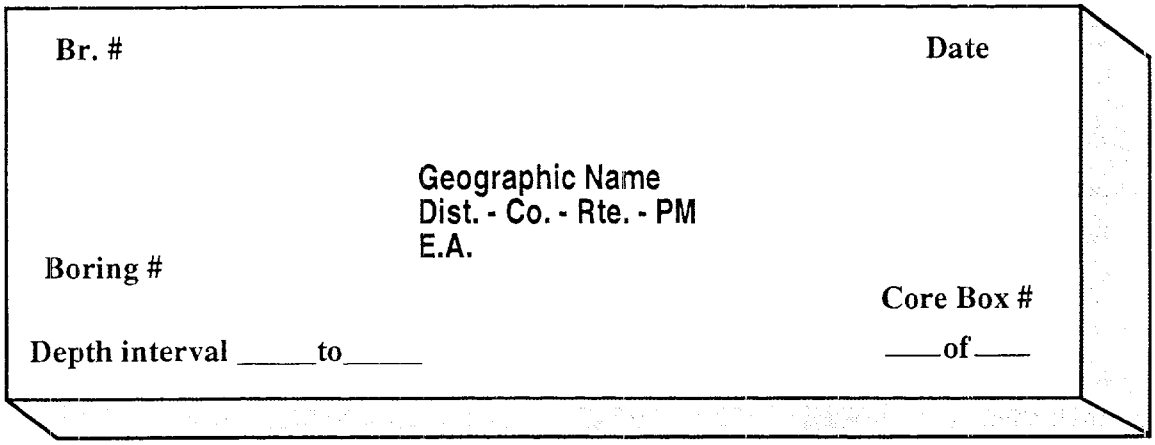
Describe the odor if organic or unusual. Rock containing a significant amount of organic material usually has a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor often may be revived by heating a moistened sample. If the odor is unusual, such as a petroleum product or other chemical, it shall be described and identified.

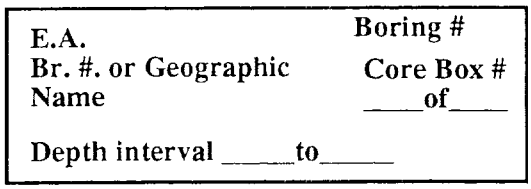
2.16 Other Constituents / Characteristics

Additional constituents and/or pertinent rock characteristics not included in the previous categories should be described depending on the scope and objectives of the project. This section should also include any pertinent information from the exploratory program.

2.17 Core Box Layout

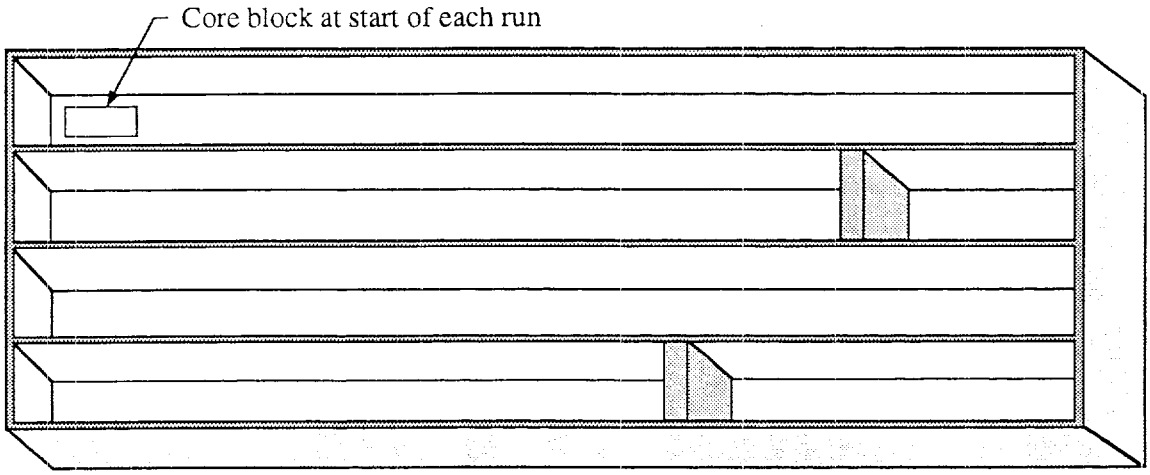
Top of Core Box

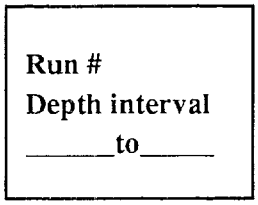




End of Top and Bottom

Bottom of Core Box





Core Block

3.0 References

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SOIL AND ROCK MANUAL PREPARED BY:

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